TRUST-AM

Trust and Reliability through Unified Simulation and Testing for Additive Manufacturing

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All charts credit: NASA

What is TRUST-AM?

- Hardware and software platform to prototype **computational materials-informed qualification and certification (Q&C)**

- Centralization and standardization of data formats
  - Major focus on data-at-rest and documentation
  - Team awareness of available datasets and models

- Backbone for data interoperability
  - Experimental data ←→ model results
  - Access and query data repository
  - Working towards full spatial and temporal data registration

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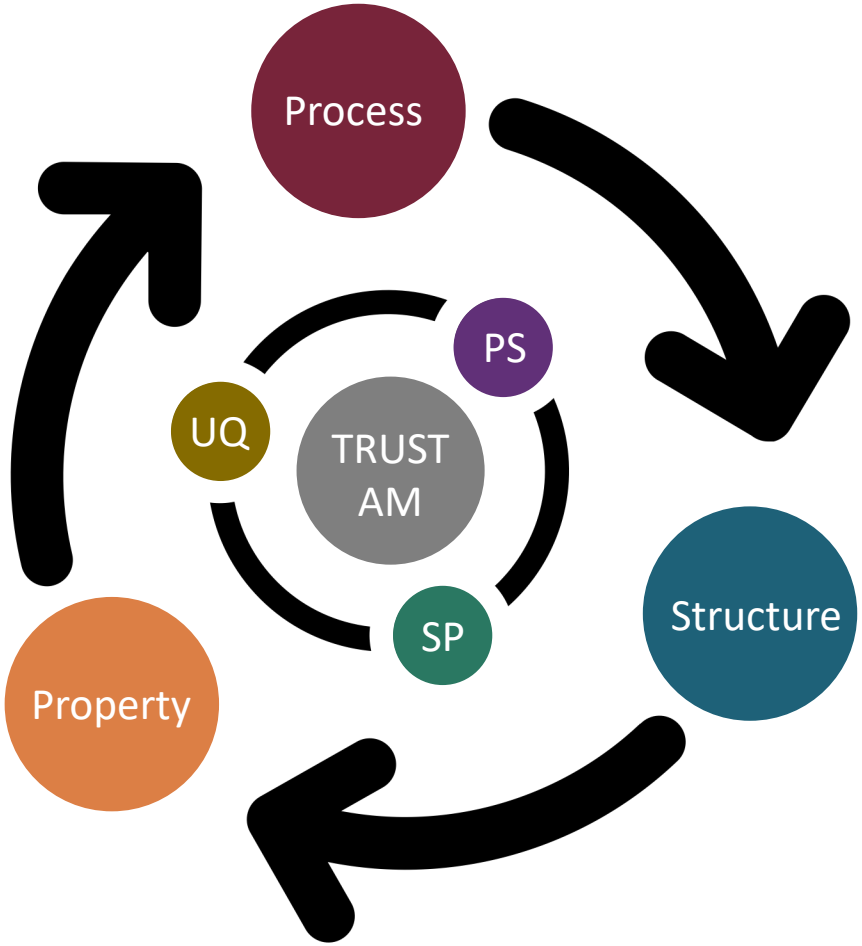
Developing AM Capabilities at NASA LaRC



Modeling capabilities

- Thermal history
- Process control
- Microstructure evolution
- Defect formation
- Crack nucleation
- Crack propagation
- Fatigue damage accumulation
- Fatigue time scaling
- Grain-scale constitutive model
- Microstructure and surface

Measurement capabilities

- Melt pool imaging
- Thermal rise
- Optical/ electron microscopy
- Automated serial sectioning
- Electron backscatter diffraction
- X-ray computed tomography
- High-resolution strain
- In-situ/ ex-situ fatigue loading
- Video image correlation

We develop schema around the data we have

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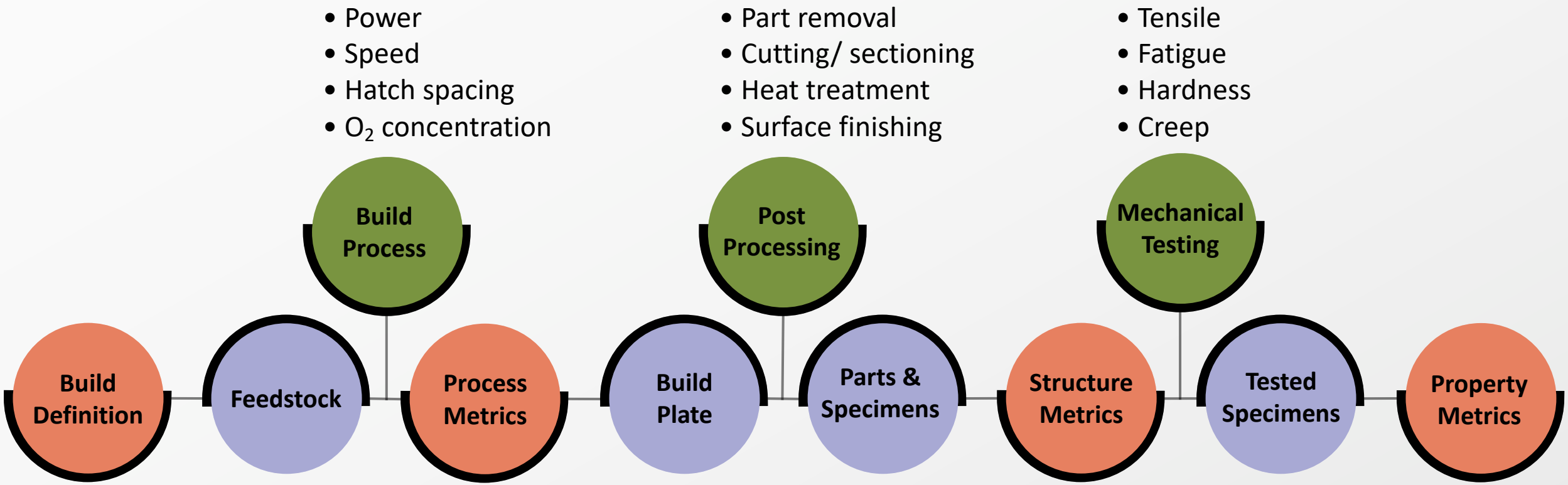
Computational Materials-Informed Qualification and Certification (Q&C)

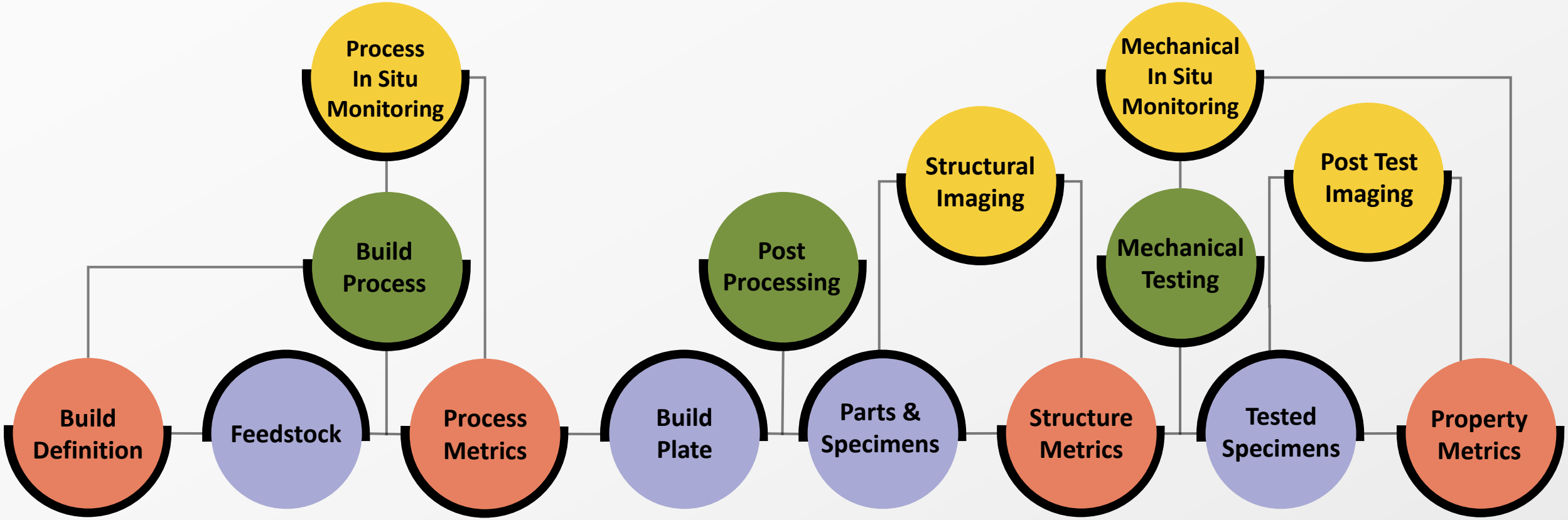
- Step 1: Populate a well-pedigreed experimental dataset
- Step 2: Systematically insert models, validate, and quantify uncertainty
- Step 3: Augment Q&C with computational modeling capabilities
- Step 4: Expand scope from coupons to parts
- Step 5: Iterate and deploy

TRUST-AM Data Model
AM Specimen Timeline



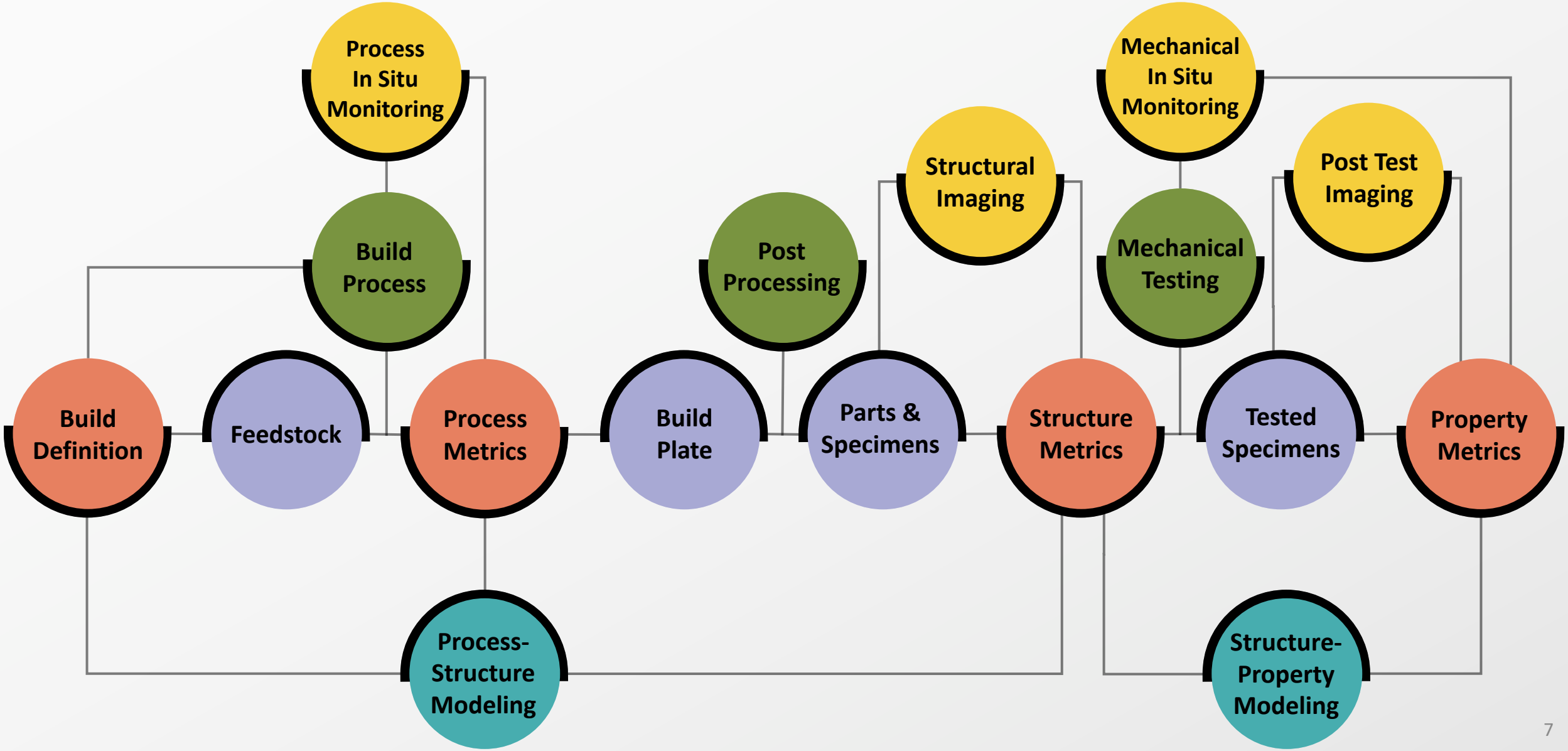
TRUST-AM Data Model

AM Specimen Timeline + Monitoring + Imaging



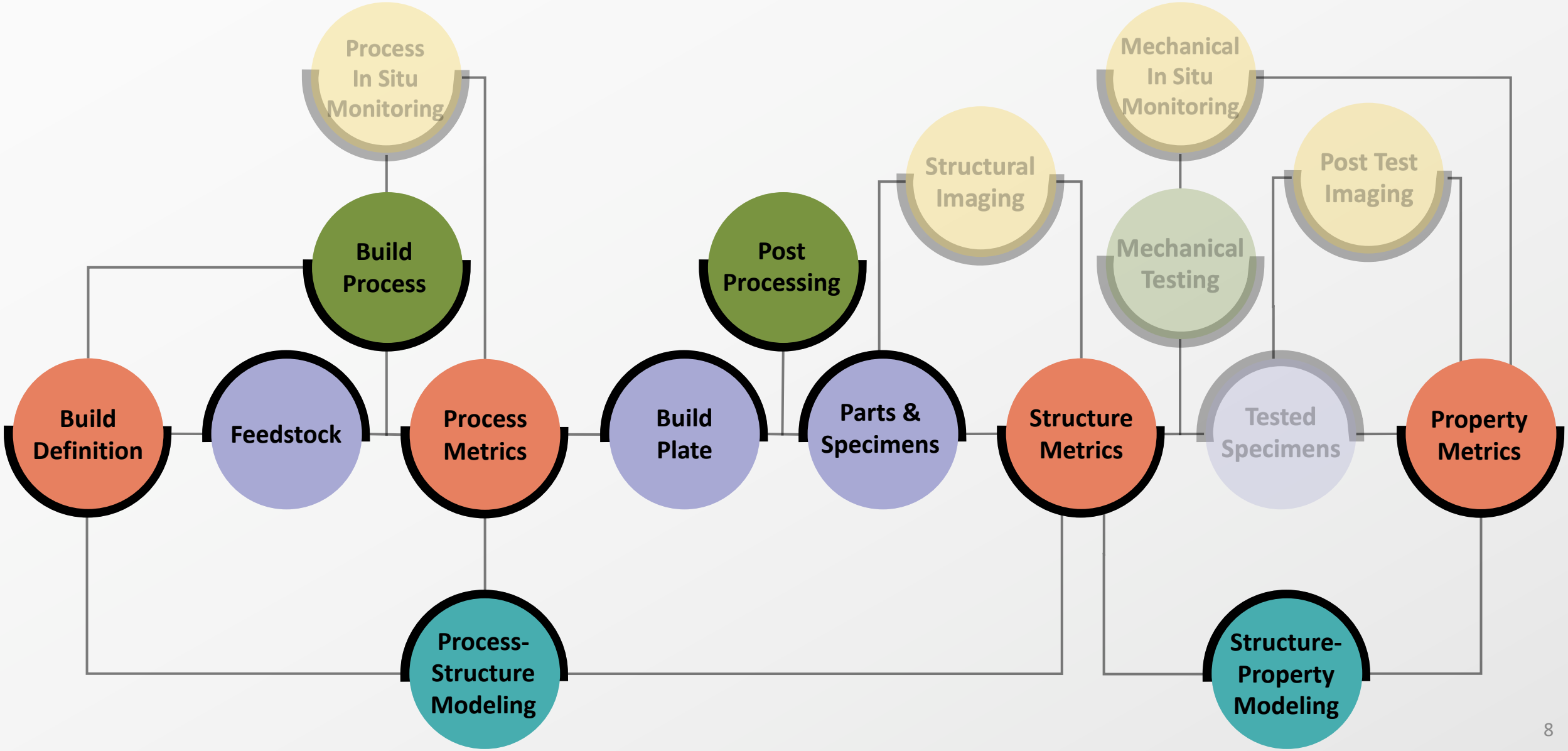
TRUST-AM Data Model

AM Specimen Timeline + Monitoring + Imaging + Modeling



TRUST-AM Data Model

AM Specimen Timeline – Lower Cost Q&C Through Model Augmentation



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Data Server and Software

- Data storage and organization
  - PostgreSQL database running 24/7 on server
  - 260+ TB of usable storage
- Version-controlled development with Git
- Interact with data
  - GUI (Dash, web-based client)
  - API (Python)

Data Toolkit

PostgreSQL

Python

Pandas

Plotly | Dash

GitLab

TRUST-AM Data Model
AM Specimen Timeline